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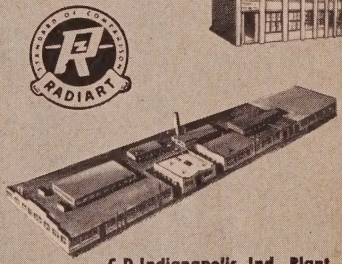

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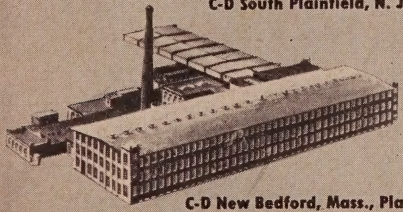

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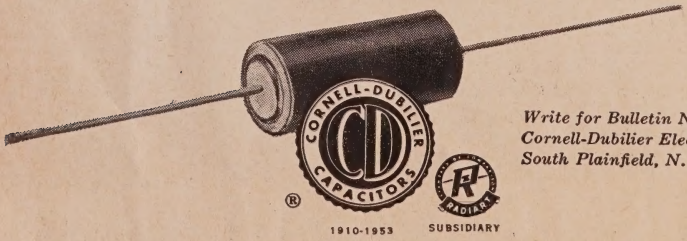

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SIMPLIFIED AUDIO-FREQUENCY MICROVOLTER

The output control in the average audio-frequency oscillator does not permit close setting of the output-signal voltage to the low millivolt levels required for testing sensitive amplifiers and similar equipment. Gain checks, frequency runs, distortion measurements, etc., often require test-signal levels not in excess of a few microvolts to several millivolts.

When accurate adjustment of the output voltage to low signal amplitudes is demanded, some type of attenuator system must be employed external to the generator. A microvolter is such a device. Commercial audio-frequency microvolters comprise some combination of step-type and continuously-variable attenuator circuits, together with a self-contained voltmeter for standardizing the circuit at a reference signal level. Such instruments usually are complicated in design, require pad-type controls, and are not duplicated easily and at modest cost by the experimenter.

Since the microvolter nonetheless is recognized as an essential instrument in the audio laboratory and shop, the Editors have studied various means of simplifying its design so as to permit easy construction and calibration of an accurate but inexpensive instrument. This article describes the simplified microvolter.

Principle of Operation

In most applications, a potentiometer-type of attenuator will suffice for signal-voltage division, provided the device is calibrated carefully. The variable output impedance of this

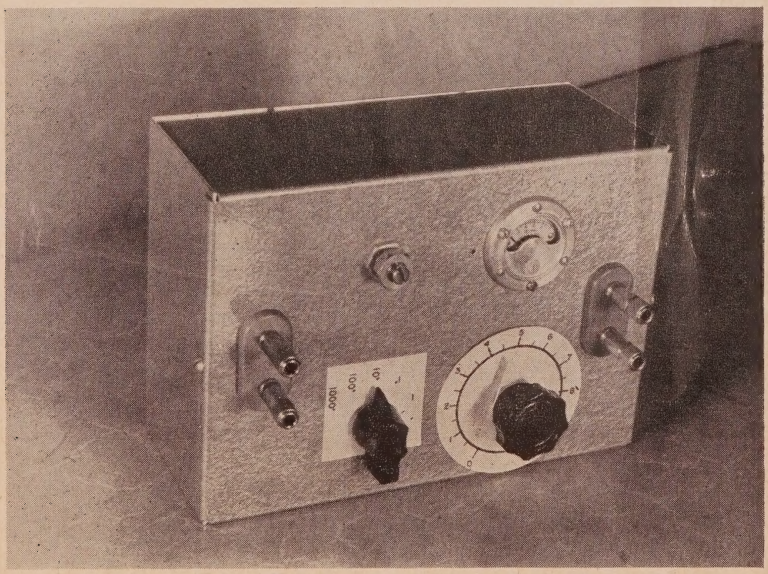

Fig. 1. Simplified Audio-Frequency Microvolter for General-Purpose Testing.

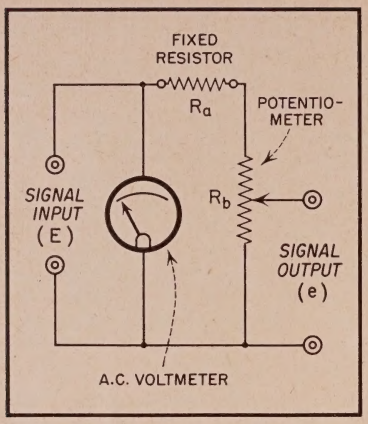

Fig. 2. Basic Circuit of the Simplified Microvolter.

simple attenuator usually will introduce no inconvenience when working into high impedances (at least 10 times the maximum resistance setting of the attenuator), as so often is the case in testing audio equipment.

Figure 2 illustrates the basic arrangement of the simplified microvolter. The potentiometer consists of a continuously variable section, R_b, in series with a fixed resistance, R_a. In terms of the input voltage, E, the maximum value of the output voltage (e) corresponding to the maximum-resistance setting of R_b is equal to:

Equa. (1) $e = (ER_b)/R_a+R_b$

Where each voltage is in volts, and all resistances are in ohms.

If the adjustable section (R_b) is set to some value lower than its maximum resistance, the right-hand side of Equation (1) must be divided by 1/f, where f is the percentage of maximum resistance represented by the setting of R_b. If the full value of the input signal voltage, E, is desired at the output terminals, fixed resistor R_a must be short-circuited.

If the input signal voltage, E, always is adjusted to some reference level, as indicated by the voltmeter, by means of the output control in the signal source, a dial attached to R_b may be made direct-reading in volts, millivolts, or microvolts.

By selecting a satisfactory set of switched values for R_a, decimal multiplication of the R_b readings can be obtained. For example; if R_a is made 9 times R_b, output voltages (e) at various settings of R_b will range from 0 to 0.1 E. Similarly; if R_a is made 99 times R_b, the output voltage (e) will be adjustable between 0 and 0.01 E. If E is held constant at 1 volt, as indicated by the voltmeter, the output voltage in the first case will be 0-0.1 v. (0-100 millivolts), and in the second instance will be 0-0.01 v. (0-10 millivolts).

For simplicity, the self-contained voltmeter may be of the non-electronic type. However, for wide frequency response without shunt-capacitance errors at the higher audio frequencies, germanium diodes should be used instead of the usual copper oxide meter rectifiers.

An examination of the basic circuit will show that the impedance exhibited to the signal source will vary as different values of range resistance (R_a) are switched into the circuit. This should cause no difficulty in most cases however, since the input voltage, E, may be readjusted to the standard value (say, 1 volt) after each switching. Similarly, the impedance at the output terminals of the instrument will be equal to the resistance of that portion of R_b included between these terminals. For that reason, a low-resistance potentiometer is used for R_b. The microvolter usually operates into a high-impedance device, such as the grid input circuit of an amplifier, which will bridge R_b effectively.

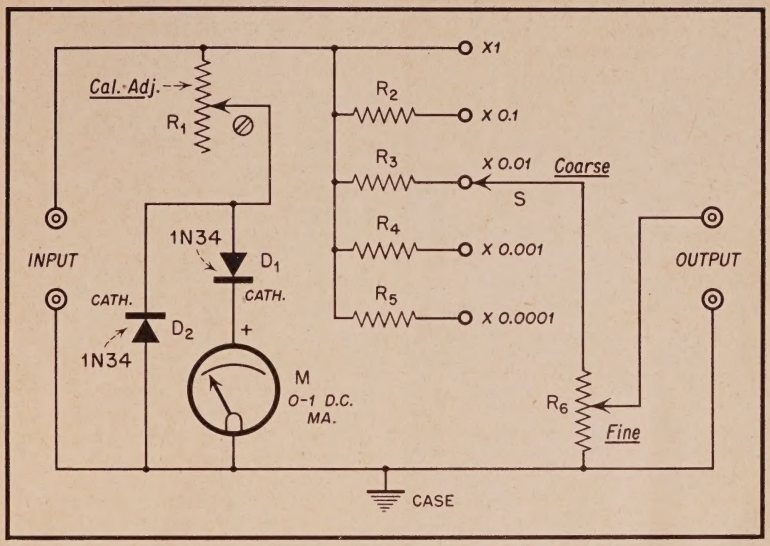

Fig. 3. Complete Circuit of the Simplified A. F. Microvolter

Complete Circuit

Figure 3 shows the complete microvolter circuit. Here, fixed resistors R_2, R_3, R_4, and R_5 are switched into the circuit by means of the COARSE CONTROL switch, S, and correspond to resistor R_a in the basic diagram, Figure 2. Potentiometer R_6 is the continuously variable FINE CONTROL and corresponds to R_b in Figure 2.

The reference voltmeter circuit consists of the 0-1 d.c. milliammeter (M), two Type 1N34 germanium diodes (D_1 and D_2), and the adjustable multiplier resistor (R_1). With 1 volt r. m. s. applied to the INPUT terminals, R_1 is adjusted during the initial calibration for exactly half-scale deflection of the milliammeter. R_1 is provided with a slotted shaft for screwdriver adjustment.

With exactly 1 volt input, as indicated by half-scale deflection of the meter, the output voltage obtained over the range of adjustment of potentiometer R_6 will be 0-1 volt when switch S is in its X1 position. This is because no limiting resistor then is in series with R_6. With S set to its X0.1 position, the output voltage is 0-0.1 v. Similarly, the output voltage is 0-0.01 v. (0-10 millivolts) when S is at X0.01, 0-0.001 v. (0-1 mv.) when S is at X0.001, and 0-0.0001 v. (0-100 microvolts) when S is at X0.0001.

The range resistors (R_2 to R_5) are ½ watt precision, non-inductive components with an accuracy rating of 1% or better. Either non-inductive wirewound instrument resistors or Continental Nobeloy resistors may be used. It will be noticed that the resistance values specified for R_2, R_3, and R_4 do not correspond to exact calculated values. The reason for this is that standard values which are more readily obtainable can be used

without appreciable error. For example, the calculated value for R_3 is 49,500 ohms. This is an odd value which would have to be obtained by series-connecting at least three resistors. However, the specified standard 50,000-ohm value (instead of the calculated 49,500 ohms) results in an error in the potentiometer circuit of only 0.01 percent. In the case of the 500,000-ohm unit (R_4), the error occasioned by not using the calculated 499,500 ohms is only 0.0001%.

The FINE CONTROL potentiometer, R_6, is a 500-ohm wirewound unit. A linear taper is recommended. There is strong argument that the better frequency response of a composition-type control in this position offsets its inferiority to the wirewound type as regards long term resetability. It is advisable to select R_6 with the aid of a good ohmmeter or resistance bridge, choosing the unit which is exactly 500 ohms at maximum clockwise setting and which reaches closest to zero resistance at its extreme counter-clockwise setting.

Individual builders who desire other ranges than the decimal ones shown in Figure 3 may add corresponding fixed resistors of appropriate value to the range switch, S. The fixed resistor required for a desired range may be calculated with the aid of the following equation:

Equa. (2) $R = (500/e) - 500$

Where R is the required resistance (in ohms),

e, the desired output voltage (in volts) at the maximum-resistance setting of the 500-ohm FINE CONTROL.

Example: What fixed resistance will be required for a range of 0-250 millivolts (0-0.25 v.), assuming 1-volt reference level for the microvolter? Here, $e = 0.25$. Substituting in Equation (2):

$R = (500/0.25) - 500 =$
$2000 - 500 = 1500$ ohms.

Mechanical Construction

Figures 1 and 4 show details of the completed instrument. This version,

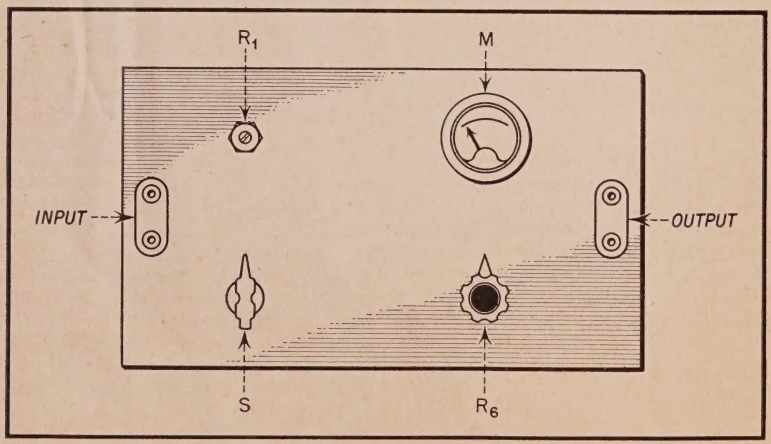

Fig. 4. Panel Layout. (Compare with Fig. 1.)

of which a number of arrangements are practicable, is built into an enamelled aluminum "chassis box" 7" long, 5" high, and 3" deep.

A 1-inch-diameter milliammeter is shown, but regular 2-inch and 3-inch meters may be employed if a somewhat larger cabinet is chosen. The 1-inch meter is International Instruments, Inc., Model 10. Identification of the controls and terminals visable in Figure 1 may be made by referring to the panel layout sketch, Figure 4.

Rheostat R_1 has a slotted shaft for screwdriver adjustment and is provided with a shaft-locking nut (See Figure 1). Since this control need be adjusted only when calibrating the instrument, the lock prevents accidental disturbance.

Resistors R_2, R_3, R_4, and R_5 are connected by their pigtail leads directly to the terminals of switch S. This connection serves as a mechanical support for them. The resistors should be spaced as far apart as possible to minimize shunting capacitance which acts to limit the high-frequency operation of the instrument.

Each of the diodes (D_1 and D_2) is connected between a terminal of the milliammeter and the wiper terminal of the rheostat, R_1. No additional mechanical support is required for them.

The components should be mounted solidly. Any wiring between terminals and components should be made with rigid busbar (no smaller in size than No. 14 solid wire.) To minimize stray capacitances, all wiring should be kept clear of the metal cabinet.

The binding post terminals are National Type FWH. Because of the relatively large clearance holes necessary for the shoulders of the insulating blocks, these terminals provide minimum capacitance to case and panel. The lower binding posts (input and output) are connected together with a length of No. 12 or 14 solid bus wire which also picks up the negative terminal of the milliammeter and the lower end of potentiometer R_6 exactly as shown in Figure 3. **Do not connect these terminals and components directly to the metal case and cause signal currents to flow through the case.** Notice that the bus lead is connected to the case **at one point**, also as shown in Figure 3.

Calibration

Fine Control. (1) Disconnect temporarily the lead between switch S and the top of the FINE CONTROL potentiometer, R_6. (2) Connect an accurate ohmmeter or resistance bridge to the microvolter OUTPUT terminals, using short heavy leads. (3) Set potentiometer R_6 exactly to 500 ohms, as indicated by the ohmmeter or bridge. (4) Mark this point 10 on the dial of R_6. (5) Next, set R_6 to 475 ohms. (6) Mark this point 9.5 on the R_6 dial. (7) Set R_6 successively to each of the resistance values shown in the Table, Figure 6, and mark the corresponding scale numbers on the R_6 dial. (8) After all points have been checked in this manner, remove the dial and ink-in the graduations and figures permanently. Then re-install the dial. (9) Recheck several points after the dial has been replaced and shift the pointer, if necessary, to compensate for any movement in position which might have taken place. (10) Reconnect the lead between switch S and potenio-meter R_6. (11) If the potentiometer accidentally should be moved at some later time during use of the microvolter, the pointer should be realigned with the dial scale, as described in the foregoing instructions, with the aid of an ohmmeter or bridge. In this instance, one dial point usually is all that need be checked.

Standardizing the Voltmeter. The internal voltmeter is standardized by

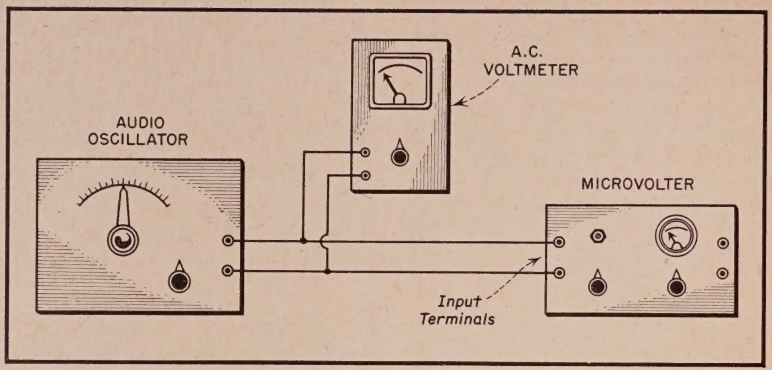

Fig. 5 Setup for Standardizing Microvolter.

feeding a known 1-volt r. m. s. signal into the INPUT terminals of the microvolter and adjusting rheostat R_1 for exact half-scale deflection of the milliammeter, M.

The following steps are recommended: (1) Set switch S to its X0.0001 position. (2) Have nothing connected to the OUTPUT terminals. (3) Connect the INPUT terminals of the microvolter to the output of an audio oscillator in parallel with an accurate a. c. voltmeter (preferably of the vacuum-tube type), as shown in Figure 5. The frequency of the oscillator should be 1000 cycles. If an oscillator is not available, the 60-cycle power frequency may be obtained from the low-voltage secondary of a filament transformer. A Variac in the primary of the transformer will be required for accurately setting the output-signal voltage. (4) Set the test voltage exactly to 1 volt, as indicated by the standard voltmeter. (5) Adjust rheostat R_1 in the microvolter for exact half-scale deflection of the milliammeter, M. (6) The microvolter reference meter now is standardized and the shaft lock may be tightened on rheostat R_1. Subsequently, when the output of a signal source feeding the microvolter is adjusted for half-scale deflection of the milliammeter, the operator will know that 1 volt is being applied to the instrument's attenuator circuit and that the microvolter dials indicate the output voltage accurately.

Application

Generator Attenuator. The basic use of the microvolter, as pointed out earlier in this article, is to provide a calibrated attenuator for audio oscillators and signal generators which do not have self-contained attenuators of a comparable sort.

In this application, the generator output terminals are connected to the microvolter INPUT terminals. The generator output control then is adjusted to give half-scale deflection of the milliammeter in the microvolter. The load device which is to receive the signal is connected to the microvolter OUTPUT terminals. The desired test-signal amplitude then is obtained by setting the COARSE and FINE microvolter controls for that voltage level.

For best accuracy when using this simplified microvolter, or any similar potentiometer-type of attenuator, the

impedance of the load device should not be less than 10 times the maximum resistance presented at the microvolter OUTPUT terminals. In the case of the instrument described here, this means that the load impedance should not be less than 5000 ohms.

Because of the varying input impedance exhibited by the simplified microvolter, the generator output voltage should be readjusted, if necessary, whenever switching ranges in the microvolter, to restore half-scale deflection of the meter.

Gain Measurement. Voltage gain can be checked readily in high-gain amplifiers by using a microvolter. No sensitive a. c. millivoltmeter then is needed. The following procedure is recommended: (1) Connect the test-signal source to the INPUT terminals of the microvolter. (2) Connect the lower OUTPUT terminal of the microvolter to the amplifier ground. (3) Connect a shielded test probe to the upper OUTPUT terminal of the microvolter. (4) Terminate the amplifier with an impedance-matching load (loudspeaker or power resistor). (5) Touch the test probe to the grid of the amplifier output stage, and adjust the generator and microvolter to give a readable deflection of an output meter connected in parallel with the amplifier load device. Inspect the waveform of the amplifier output. If overload distortion is evident, reduce the microvolter output. (6) Record the output meter reading as E_1. (7) Record the corresponding microvolter reading as E_2. (8) The voltage gain (G_1) of the last amplifier stage then is E_2/E_1. (9) Transfer the test probe to the grid of the preceding amplifier stage. (10) Reduce the setting of the microvolter until the same output meter reading (E_1) is obtained as before. (11) Record the new reading of the microvolter as E_3. (12) The voltage gain (G_2) of the two stages then is E_1/E_3. (13) the voltage gain of the last stage checked is G_2/G_1.

By moving "backward" in this manner through an amplifier, the voltage gain of circuits and stages and of the entire amplifier may be checked.

PARTS FOR FIGURE 3

D_1, D_2—Type 1N34 germanium diodes
M—0-1 d. c. milliammeter
R_1—10,000-ohm wirewound potentiometer
R_2—4500 ohms ½ watt 1% percision resistor
R_3—50,000 ohms ½ watt 1% percision resistor
R_4—500,000 ohms ½ watt 1% precision resistor
R_5—5 megohms ½ watt 1% precision resistor
R_6—500-ohm wirewound potentiometer — linear taper
S—Single-pole, 5-position, non-shorting, rotary selector switch

Resistance of R_6 ohms	Dial Reading
500	10
475	9.5
450	9
425	8.5
400	8
375	7.5
350	7
325	6.5
300	6
275	5.5
250	5
225	4.5
200	4
175	3.5
150	3
125	2.5
100	2
75	1.5
50	1

Fig. 6. Calibration Chart for Fine-Control Potentiometer.

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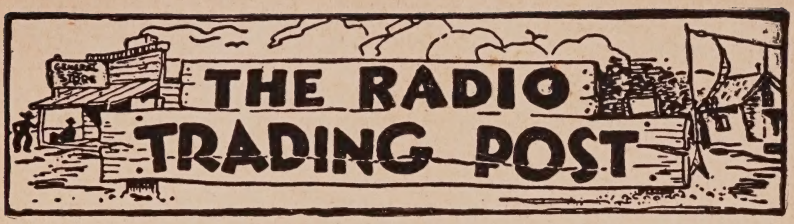

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FOR SALE—Supreme 504 portable tube and set tester, $50 FOB. Victor record changer attachment model 9-JY., $8. Both in excel. cond. Harry A. Pratt, 27-05 First St., Astoria, L. I.

FOR SALE—Music, Record, TV, Radio Sales and service store. Estab. twenty years. Dollar for dollar for inventory. Can lease, or buy building with two apts. Bryan, 214-81 Jamaica Ave., Queens Village, N. Y. City, N. Y.

CASH—for best offer of McIntosh, Brook, or Fisher amplifier. State model, number, and price. G. A. Jury, 171 Seminole St., Mobile 18, Ala.

FOR SALE—Dumont 7EP4 C.R.T., $5; Vibroplex Bug, case, and "Bud" code practice oscillator, $14. Marvin Shapiro, 1240 Sherman Ave., Bronx 56, N. Y.

TRADE—Tube Tester R.C.P. model 315. Want photo enlarger or what have you in photo line. P. R. Patterson, 615 Blair St. Hollidaysburg, Pa.

FOR SALE—Pickering: LP cartridge, new diamond stylus, $25; 78 cartridge, sapphire stylus, $6; 190 pickup arm, like new, $17. All three, $45. 24-hour inspection if by express. L. M. Carling, Sand Lake, Mich.

FOR SALE—Revere T-100 Tape Recorder. Plays 1 hr. at 3¾" with dynamic mike. Excel. cond., $110 FOB. Douglas Phillips, 311 Penfield Place, Rockford, Ill.

FOR SALE—Awater Kent radio spkr. and tubes, model 60, $3.50; Majestic model 130A, tubes and spkr., $3.50, etc. Enclose stamp for list. Louis A. Goldstone, 1279 Sheridan Ave., Bronx 56, N. Y.

SELL—NRI Mulitester complete with batteries and AC—RF head, 1952 model. Works perfect, instructions included, $5 plus postage. Donald Walker, 125 Guess St., Greenville, S. C.

WANTED—Hallicrafter S 40B in good cond. Cash, local deal preferred. Arnold Moscowitz, 213-02 75th Ave., Bayside 64, N. Y.

WANTED—Standard coil tuner TV 2032 and take off coil XM-752, tenna-top booster, sweep gen. Have projectors, cameras, TV test equip., boosters sig. tracers, condenser testers, etc. John Arnold, P O Box 84, Bluffs, Ill.

WANTED—Telefunken radio tubes. AZ-12 EL-12, AC-2, will pay cash. Have tube tester, Precision 912 with adaptor,$30; Pocket meter, $5; DeWald model BT-100 television, $50. Rolland Sales, 5219—9 Ave., Brooklyn 20, N. Y.

FOR SALE— 15 w. ant. tuner, Bud RLS coils 10-20-80, wrks fb on 4 too. Swinging link. Coax fitting in, on chassis, $15. Also ARC, 5 xmtr power supply, regulated, 12v fil, 500 v., B+, 250v int. B+, $10. Herbert Greenberg, 821 Rutgers Rd., Franklin Sq., N. Y.

SELL OR SWAP—Battery Eliminator, Heathkit BE-2, perf. cond., $20 cash, or $22.50 worth of tubes of my choice at 50% off list, plus postage. C. Elgasser, Jr., 1920 Fern St., San Diego 2, Calif.

SWAP—Good test equip. for surplus such as BC-221, BC-342, R-77, etc., or what have you? S. Consalvo, 2507 Southern Ave., SE, Washington 20, D. C.

WANTED—Television Retailing Publication from Sept., 1952 to Jan., 1953, TV Electronic Technician Section only. State price. V. Kozma, 1665 Stadium Ave., New York 61, N. Y.

FOR SALE—Small storage batteries, $2 ea. Aircraft motors, 27 v., 4 HP with ball-bearings, $2 ea. perf. cond. Eric Scholer, 209 Glengary Rd., Schenectady 4, N. Y.

CASH OR TRADE—Want Standard 78 rpm code records, alphabet thru 13 words per minute. Have coin changers, radio and TV., Science, Mechanics Magazines. Joseph DiTucci, 234 Parkway, Rochester 6, N. Y.

SALE OR TRADE—Broadcast Studio type mixer, and pre-amplifier. Ten 20 ohm and 2 Hi-Z inputs orig. cost $1200. Also 18½ w. transformer coupled amplifier ± ½ db 50 to 15,000 cps., $200 J. C. Bradley, 427 No. Euclid, Ontario, Calif.

WANTED—Power Transformer, new or used good cond. and Dial Escutcheon for RCA model HF-2, 12-tubes. F. LaFave, 35 Woodland Rd., Wakefield, Mass.

FOR SALE—400 w. Garfield Diathermy Machine, model S-325-G, 27,300 KC, xtal controlled. Easily convertible to ham transmitter. Sidney Malet, 600 Eastern Parkway, Brooklyn, N. Y.

FOR SALE—SX17 receiver, $50; phone patch with plugs, $3.50, F.O.B. guaranteed. Epps Griffin, Box 1074, Mt. Pleasant, Tex.

FOR SALE—Model 360 TV-FM Eico Sweep Sig. Gen. Never used Calibrated 0-30 MC. Also mod. 425 Oscilloscope, any reasonable offer. Arthur Porcelan, 1627 East 2d St., Brooklyn 30, N. Y.

SELL OR SWAP—⅓ H.P. GE Capacitor Start Motor; 1940 Buick Sonomatic radio; Beacon II Camera with flash attachment. All in exc. cond. Want 7" TV set or ? Cass Radio and TV, 840 Cass Ave., Kingsford, Mich.

FOR SALE—Standard Tuner in good working order, $10; color wheel, $5; tool and tube caddy, $6 and 78 RPM record changer, $7. Karl's TV Service Co., 389 MacArthur Ave., Garfield, N. J.

WANTED—Used radios, parts, tubes, test equip., etc. Edwin Lee Herman, 2479 Shirley Ave., Baltimore 15, Md.

FOR SALE—7" RCA Victor TV set. Model 621TS, $23, express charges collect. Jones Radio Co., Douglassville, Pa.

TRADE—New 813 Transmitting tube for 100 ft. of RG84 Coax cable. Roy Hanson, 721 South State S., Westville, Ill.

FOR SALE—Model 661 Serial 606 Supreme Sig. Gen., $30; Model CA12 Superior Inst. Meter Co. Sig. Tracer, $10; Model TC48 Test Craft, $10. New York City only. Rudolph Chlupsa, 45-56 189 St., Flushing 58, N. Y.

SWAP—National Radio - TV correspondence course—less equipment or 1937 auto radio (Chevy) complete for signal tracer or tube tester in good cond. R. L. Schaeffer, 18800 Puratas Ave., Cleveland 11, Ohio.

FOR SALE—Like new and postpaid for $4 each. IRC type LC-1 Loudness Control, and two 8 ohm magnetic cutting heads for General Industries Disc Recorders. Milton Kalashian, 2 Congress St., Newburyport, Mass.

FOR SALE—Royal Air Force R1154 radio receiver, complete with 240 v. power pact and matched loud speaker. A. Glass, 9401 - 64 Rd., Forest Hills, New York 74, N. Y.

FOR SALE—Garrard RC60 record changer, complete with GE Reluctance or Hi-Fi astatic cartridge. Unit in perf. cond., works automatically. Best offer. Vincent Pellettieri, 5523 31st Ave., Woodside 77, L. I., N. Y.

SELL OR SWAP—RCP Sig. Gen. 705A, very good, $25; Superior Super Meter Mod. 670, measures AC DC volts, ohms, amps, cap., and inductance, excellent, $20; Carl Zeiss 8x30 Binocs with case, $65. P. Kacoure, 148-09 Jamaica Ave., Jamaica 35, N. Y.

SELL OR SWAP—Transceiver (AR11) in portable carrying case 50 w. CW on 20, 40, 80 meters operates from 110 v. AC. James E. Loff, 7115-3 Avenue 2-B, Brooklyn 9, N. Y.

WANTED—Westinghouse Portable Radio model H312PH. Louis DeMorca, Jr., 2 Clay St., New Haven, Conn.

WANTED—Rider Manual 21 only state price including parcel post and insurance prepaid. Elton Hoornstra, 305 Ann St., Sault Ste. Marie, Mich.

SELL OR TRADE—Like new TU-10-B tuning unit, $3.50; 200 amp. Arc Welder made from an aircraft gen. in working cond., $100. Trade for new radio tubes, speakers, vol. controls, vibrators of national brands and boxed. Gerald R. Kernan, Harpers Ferry, Iowa.

SWAP—Conn Tenor Saxophone in perfect cond., with case, for tape recorder in good cond. E. L. Grimshaw, 174 Water St., No. Andover, Mass.

FOR SALE—Electronic Radio Course, $25; like-new NRI Service Manual Vol 1, $12; Malley Battery Booster, $7. Cash only and postage. Travis Heard, 10260 Oakland, Detroit 11, Mich.

WANTED—National NPW3 Condenser with Micrometer Dial, 225 MMF per section, 3 gang, each rotor individually insulated from frame. Stephen O. Kucera, 2105 McElderry St., Baltimore 5, Md.

FOR SALE—Like new Masco 75 w. amplifier with 4 spkrs in splitcase P.M.; 2 25 w. driver units (University); 2 Atlas Projectors 20" dia.; 2 mikes; 1 record player (automatic) complete, $250. M. McDevitt, 17 Monument St., Charlestown, Mass.

WANTED—Philco Training and Trouble Shooting Manual and Technical Manual for BC 348-R. H. J. Stolten, 220 Rock St., Easton, Pa.

FOR SALE—DeForest Radio and TV Course: 120 lessons, taken in 1947, $15; Radio and TV books and magazines. T. Wojciechowski, 2837 Fulton St., Brooklyn 7, N. Y.

WANT—Communications, June-July, 1939; RCA Rev., Jan., 1939; I. E. E., June, 1936. R. Silberstorf, Philco Engineer, Navy Radio Station (T), Navy 926, F. P. O., San Francisco, Calif.

FOR SALE—(20) Gen. Time Inst. Corp. Model M2-F electric clock motors; prewar record changers and parts (used); BC-729-C antenna tuning unit, complete. Bill's Radio and TV Service, 9956 So. Normal, Chicago 28, Ill.

WANTED TO BUY—Old table or floor model, Majestic 16-tube radio, model 11656. State cond. and price. C. M. Dunham, 8 Norwich St., Worcester, Mass.

FOR SALE—TV Sweep Gen., TS-2 (xtal markers) $45; Sig. Gen., SG-7, $19; Sine and Sq. wave gen., G-2, $29; Sonar NBFM xmtr (10M), $17. Joseph F. Dineen, 9 Winter Terr., Westwood, Mass.

SELL—National AC SW-3 Receiver with tubes, $15; 5880-AB Power Supply for same, $13; 23-41 Meter Coils, $2.50; 80 Meter Band Spread Coils, $2.50. All in excellent cond. T. B. Winstead, Elm City, N. C.

FOR SALE—G. E. Ken Rad tubes (in orig. boxes) most types at 50%; also 10" Crosley TV with FM; 16" G. E. mahog. console ½ doors, perf. cond. No reasonable offer refused. Zenette ac-dc port, $15. John Magnus, 9415 So. 55th Ave., Oak Lawn, Ill.

WANTED—New or used 1949 Chrysler auto radio ready to install. Melvin Sher, 471 Tremont Ave., Orange, N. J.

SELL OR SWAP—Precision model E-200-C Sig. Gen., never used, will trade for tape recorder or cash. Ev. Evancich, 322 Oswego, Park Forest, Ill.

FOR SALE OR TRADE—2 AN/6RC7 VHF walkies talkies and other misc. equip. George Oelkers, 222 No. Lemon St., Anaheim, Calif.

WANTED—TS-2 Heathkit Sweep Gen. or equivalent. Don Reiser, 4220 Dresden St., Kensington, Md.

FOR SALE—Like new 4" O-1 M.A. meters, 50-ohm internal resistance, in square bakelite case, with VOM scale and knife-edge pointer in original boxes—$5.50 postpaid. L. Cohen, 151-09-34th Ave., Flushing, N. Y.

WANTED—4 Kennedy 5-D small parts cabinets, five drawers with dividers, best price under $10 each, must be in good cond. D. L. Beatty, 4216½ Main, Kansas City, Mo.

SELL OR SWAP—Brush Sound Mirror BK-401 tape recorder, tapes; Gardner tape machine, all tapes; 110 v. "TAC" code oscillator; Pair Bendix selsyns 110 v. type 11-2; Super Sonic TV amplifier; Meissner Sig Shifter model 150-B with all coils. Carroll Rush, 721 Colorado Ave., Louisville 8, Ky.

SWAP—Waterman model S-10A portable oscilloscope, 2" CR tube weak. Need Analyst, Chanalyst, etc. Need not be in perf. cond. if panel is OK. Donald Anglin, Radio Hospital, Groom, Tex.

WANTED—HRO National Receiver or SW-3 and 1-10 National Receivers. Will swap NRI Comm. Course (with most parts), Vibroplex Automatic Key, ICA Code Oscillator. C. C. Laster, 1136 Merrill St., New Orleans 14, La.

SELL OR TRADE—Westinghouse 3" DC MA Square 0-100, 0-150, 0-400, $3.65 ea.; ten 813's, $6.95 ea.; HK54, $2.95; Speed-X Bug, $7.95; BC 459 converted. Make offer. List on request. Want oscilloscope R. V. Rosellini, 2619 So. Gaylord, Denver, Colo.

FOR SALE—Radio-TV Sales and Service estab, 11 years, good equip., newly decorated. Low rent or will sell bldg. with living quarters. 3 TV franchises. City will have VHF-TV station in June. James A. Johnson, Gen. Del., Rochester, Minn.

FOR SALE—Tubes, tape and disc recorders; 25 w. xmtr; radio parts, meters, crystals, stamp collection. Send for list. Need cash. Wayne N. Storch, 507 Buell Ave., Joliet, Ill.

WANTED—C-D BF50 Condenser Analyzer. Will sell Heathkit TS2N TV Sweep Gen., $30; Transvision chassis with 10 BP4 tubes, $40. W. Mimna, 271 No. 6th St., Newark, N. J.

WANTED—NRI Sig. Tracer, model 33 or 34. Prefer model 34. DeVoe Radio Service, Spring Green, Wis.

SELL OR TRADE—Tube Tester, VOM, replacement parts, etc. Want portable typewriter, jig saw, lathe, or drill press. Luciano's Radio - TV Service, 516 South First St., Fulton, N. Y.

WANTED—Riders Manuals 21 to date; Lionel Standard Gauge Locomotive; Edison cylinder machine and records. Will trade Supreme testing instruments, antique radios, RCA record changer 1928, rent on beach cottage on Cape Cod. G. Hartwell, 38 Charlemont St., Newton Highlands, Mass.

TRADE—17-jewel Cortebet wrist watch; Woodstock or Remington full-size typewriters for ten (No surplus) Meter Mobile Transmitter - Receivers, or what have you? K. Stello, 4522 Sargent Rd. N. E., Washingon 17, D. C.

FOR SALE—Heath oscilloscope, model O-7; Eico VTVM, model 221; Jackson sig. gen. 100 KC to 216 MC, model 106. Equip. used very little, $120. Ernest Hartog, 900 Riverside Drive, New York 32, N. Y.

FOR SALE—Miles Walkie Recordall portable, battery-powered recorder, 1½ hr. continuous recording, built-in playback, silent telephone pickup, lapel mike, almost new, $200. John Sousa, TIME, Inc., 9 Rockefeller Plaza, New York 20, N. Y.

FOR SALE—Precision E-200 sig. gen. and Spax sig. tracer. Both used very little and in perf. cond. They are complete with all test leads and instructions, $70. Jack H. Newland, 802 O St., Bedford, Ind.

FOR SALE— Tube tester, model Supreme 589A, in orig. carton, checks late TV tubes. Best offer over $35, prepaid. Gustano, 223 So. Winebiddle Ave., Pittsburgh 24, Pa.

FOR SALE—PE-103 Dynamotor, never used, complete, $24.50 F.O.B. Washington, D. C.; Hallicrafter SX-25 comm. receiver, $49.50; Zenith 3-way, overseas portable receiver, covers short wave broadcast bands, $34 F.O.B. Vernon Esgar, 2842 South Court, Palo Alto, Calif.

FOR SALE—7" Teletone TV in working cond., $30. C.O.D. Ry. Exp.; Vee-D-X ouboard booster for Channel 5, $10. P.P.; 8-element Yagi, Channel 5, $8 C.O.D., Chuck's Radio, Box 701, Madras, Ore.

FOR SALE—ART-13 like new, $200; Dynamotor 600 v. @ 150 mils., $20; Leece-Neville Alternator complete unit 60 amp. D.C., $70. E. Adams, 755 Delafield Ave., Staten Island 10, N. Y.

WANTED—957, 958, or 959 Acorn Tubes. Will buy or sell other tubes and equip., if you would submit list. J. Cooper, Box 203, Canal Street Station, New York 13, N. Y.

FOR SALE—HT-17 complete with all coils, MK-2 converted 40 and 80, 17½" Bud DeLuxe rack cabinet, Sonar XE-10, tubes, meters, relays. Send stamp for list. G. Samkofsky, 527 Bedford Ave., Brooklyn 11, N. Y.

SELL OR SWAP—DE 101-C's, modified, $8; Heath V6-VTVM, $37 F.O.B.; Triplett VOM 2400; coil set BC 696; back issues QST Radio News, 40c ea. Postpaid. Kits wired reasonably. Want Dyna-

SELL OR TRADE—RT-7 APNI Transceiver, used; RT-34 APNS 13 Transceiver; BC-645 Transmitter, have other surplus gear, best offer. Want 8MM movie camera, test equip., or what have you? Luther Asebes, Box 296, Omar, W. Va.

FOR SALE—Used radio and TV instruments and parts in good shape; Rider Manuals, approx. 800 tubes. E. T. Williams, Box 229, Masontown, Pa.

SALE OR TRADE—A Webster - Chicago model 80 wire recorder. Fair cond., $100 or trade for a tape recorder or an accordion. John R. Willis, Passaic Ave., Caldwell N. J.

FOR SALE—BC348R comm. receiver converted to AC, $90; Ediphone Electar guitar with hi-fidelity amplifier, $90. John Halchak, 92 Lee Park Ave., Wilkes-Barre, Pa.

FOR SALE—Vibroplex Champion Key, $6.50; Johnson type D 52-52 mfd. .175 spacing, $4.50; GE 2" R. F. Meter, 0 to 8 amp., $3.50; 3 crystals with holders, 7173, 7180 and 3710 KC, $1 each. Milton Tauscher, 737 Michigan St., Hammond, Ind.

FOR SALE—Gonset 3-30 converter, $26; BC-457A, 4-5.3 MC with tubes as is, $8; 32RA Modulator, no tubes, $10; 813 tube, $6.50. H. E. Wood, 451 Manor Rd., Hatboro, Pa.

FOR SALE—Riders 1, 4 to 13, $75; 581 Supreme Sig. Gen. and Frequency Modulator; 89 Supreme Deluxe tube and set tester, A-1 cond. W. E. Menehan, 7416 5th Ave., North Bergen, N. J.

FOR SALE—Heathkit late model V-4 VTVM A-1 shape, excellent wiring job. Shipped pospaid in orig. carton, $20. Milton Kalachian, 2 Congress St., Newburyport, Mass.

WANTED—RCA stock 157 also 9572 Crystal Calibrators; Hickok model 156A Traceometer; Hickok model 209A VTVM. Paul Capito, 637 West 21st St., Erie, Pa.

FOR SALE—Western Electric 728-B Hi-Fi Speaker, like new, $21; Thordarson amp. model T-32 W10, excellent cond., $21; Western Electric Dynamotors model DM-34-D, $3. Charles W. Leigh, 162 Passaic St., Trenton 8, N. J.

TRADE—Stamp collectors, $30 cat., value good foreign, for S38 or larger receiver, working or repairable. C. Tierney, Box 59, Alameda, Calif.

WANTED—Portable 7" TV set, will pay cash, or trade Pilot Tuner FM. Akers Radio, Rural Retreat, Va.

WANTED—Used Hallicrafters or National Receiver in good cond. All bands with good C. W. Peter Cap, 233 Cook Ave., Yonkers, N. Y.

TRADE OR SELL—Obsolete Diathermy, contains PP HF 200's, 2200-vdc power supply. Convertible to 800 w., class C amplifier. Want radio rec., TV rec., Heath 0-7 scope, etc. S. Kravitz, 5019 Rorer St., Philadelphia, Pa.

SALE OR TRADE—Like new Air King mod A1000 TV 10" cabinet. Fits RCA 630 chassis. Want Sams Photo Facts or Riders Manuals. Okey Gill, Coal Fork, W. Va.

FOR SALE—Hallicrafters SX-41G comm. receiver, $15; 1947 Midwest chassis 15-tube with 15" speaker, $25; Ward FM antenna, $5. Thomas Johnson, Box 932, Tuscaloosa, Ala.

SWAP OR SELL—Assorted rifles, shot guns, good used auto radios. Want radio control gear for model airplanes, min. motors, or photo equip. Paul P. Harris, 1636 S. Springfield Ave., Chicago, Ill.

WANTED—Used RCA 630 TV chassis; Tele-King TV mod. 210 TV chassis (mention cond. and lowest price); Riders PA, TV Manual, test equip. J. W. Buda, R.D. 1, Evergreen Ave., Wickliffe, Ohio.

FOR SALE—Astatic FLC pick-up, 2 crystal carts, Diamond Stylus Astatic FL filter, Stancor output trans. A2313, Shure 710 crystal mike, RCA tubes. J. Holloway, Cent. YMCA, Philadelphia 2, Pa.

FOR SALE—Triplett Scope 3441, cost $195, sell for $150—one month old. A. Seligson, 512 E. Thompson St., Phila. 25, Pa.

FOR SALE—Silver Vomax VTVM mod 900, very little used; Pilot FM Tuner used twice, $15. Arthur Krause, Box 66, Quarryville, Saugerties, N. Y.

FOR SALE—Masco 17 w. amplifier with phono., completely rebuilt; 3 table mod. radios in excellent cond. Robert F. Cyphers, Radio and TV Service, Bartonsville, Pa.

FOR SALE—National NC-57 receiver in good condition. FOB, $50. Walter F. Rogers, Box 114, Benson, Ariz.

SALE OR TRADE—BC-342-N comm. rec., less case and spare fuseholder; slightly used 807 tubes; Mill amp. 0-500, 0-150, 0-200. Need good sig. gen., oscilloscope, or 6 v. Battery Eliminator. Les Raulerson, Box 283, Patterson, Ga.

FOR SALE—Like new Eico Oscilloscope model 425K; Eico Sweep Gen. model 360K. Irving Weiss, 504 'B' Grand St., New York 2, N. Y.

SELL OR TRADE—Assembled radios, AC-electric receiver or radio parts for a power supply. Also have large transformers, knobs. Miss Thelma Wilson, 4450 Edgewood Pl., Riverside, Calif.

FOR SALE—10" TV set, $40; 12½" TV, $90; 17" TV, $95, just needs cabinet; motor and fan blade ¼ HP, $9; Eico 5" Scope, $40. Articles guaranteed working cond. C. V. Signorelli, 133 Hammond Ave., Passaic, N. J.

SWAP—Hickok 05-10 AF-RF oscillator and NRI, VTVM for sig. tracer or mobile transmitter, receiver etc. Mobile must be for 6 v. battery or gen. Wentzels Radio, 2445 Grant St., Mt. Penn, Pa.

FOR SALE—Hallicrafters S-40-B, Teletone 7" TV, Hallicrafters 7" TV, Westinghouse 16" osc. fan DC 110 v. C. W. Peterson, 256 18th Ave. North, Minneapolis 11, Minn.

SALE OR TRADE—Portable Royal typewriter; Air King wire recorder-phono; 2 like new portable Radios; Tubes; Watches; Etc. E. G. Bartlett, Atlanta, Mo.

WANTED—All types filament, plate, and power transformers with 220 v. primary. Also 60H. 250Ma. modulation reactor. J. E. Howell, Box 126, Lumberton, N. C.

STOLEN—From amateur radio club—75A-2 Collins ham receiver and 10" Collins speaker. If located notify John F. Ring, Security Officer, Univ. of Conn., Storrs, Conn.

WANTED—A Chanalyst or Analyst in good condition, or would consider other sig. tracers. Robert Caylor, Valparaiso Tech. Valparaiso, Ind.

FOR SALE—C. D. Capacitor issues, April, 1940, to present issue, also Riders Successful Servicing, July, 1946, to Feb., 1953. No reasonable offer refused. Frank J. Connor, 3449 Thomas Ave., No. Minneapolis 12, Minn.

WANTED—Modulation Transformer for Art 13 Transmitter. Stanley M. LaDage, 431 Oakland Avenue, Maple Shade, N. J.

SALE OR TRADE—BC-433-G radio compass receiver converted to 110 v. A-C. Same as ARN-7 Receiver in perfect cond. Want binoculars or air compressor. J. W. King, Rt. 1, Noble, Okla.

FOR SALE—Transformers removed from experimental equip., speakers, booster, etc. Roland S. Bond, 6255 Desco Drive, Dallas 5, Tex.

WANTED—National NC-183, Hallicrafter SX-62 or SX-42. Cash. G. Chernowitz, 705 Grand Ave., Ridgefield, N. J.

WANTED—Parabolic Baffles model SM-12, for 12" speakers, must be below wholesale price. Wm. H. Lorimer, 432 Sheridan St., Williamsport, Pa.

WANTED—Copies of Sams' PF Index 31, 32, and 33. Will pay 50c each if copies are complete. Horace Butterworth, 2708 Gaither St. SE, Washington 21, D. C.

SELL OR TRADE—Sig. Gen., R.C.P. 705; Eico Tube Tester 625; Triplett VOM 666-HH; 135 amp. with 12" Hi-Fi speaker; sig. tracer and probe. Want Scott radio, table model, good radio-recorder playback. M. J. Donnelly, P. O. Box 607, Carson City, Nev.

SALE OR TRADE—Complete service shop, Eico tube tester, Precise VTVM, Superior tube and set tester, about 60 tubes, misc. parts, Sams Folders, Radio books, $185 or Deer Rifle, 12 ft. V-Bottom outboard. Ron's Radio, Holt, Mich.

FOR SALE—Complete 10 meter 40 W. mobile rig. Link police xmitter, home-built broad band xtal controlled conv., hand mike, master mount with usable ant., all cables and switches. Best cash offer. V. E. Freist, 1317 Summit Ave., Union City, N. J.

FOR SALE—A-1 Modulation Transformer UTC 9200-B (ART-13) primary-15000 ohms P to P Class "AB" 811's 1100 Ma. Secondary-7300 ohms Class "C" 813 1100 V. 175 Ma. Also A-1 matching 813 tube (never used) with plate cap and socket. $15 for both. E. Pinnick, 15908 Sussex, Detroit 27, Mich.

WANTED—Speaker cabinet, with or without speaker, to match a Collins 75-A-1 receiver M. Katz, 147-11 76h Avenue, Flushing 67, N. Y.

FOR SALE—Sams' Vol. I to 6, sets 61, 62 90, 96, 97, 97A, 104, 114, 149, 157 in excel. cond., $95, plus express COD. Albert C. Hart, 207 No. Raymond St., Griffith, Ind.

SELL OR TRADE—60 W. xmtr complete; Vibroplex, Speed-X MacElory bugs; 40 ham xtals; pr. 4-65A's, 829B's, 832's; xmfrs, Heath Sig. Gen. Send for list. Need auto radio or what? Jim McCoy, Whitehall, Mont.

WANTED—Back Issue copies of C-D Capacitor and QST magazine. Write Joseph J. Simpson, 85-39 152nd St., Jamaica 32, N. Y.

WANTED—Navy Selsyns or Synchros 1CT, 1G, 1HG, 1F, 1DG, 1D. Will pay $35 each; subject to inspection. A. L. Berg, 58 Eastern Ave., Boston 13, Mass.

SELL—300 w. speech amplifier-modulator with tubes, $55; Vomax 900 VTVM, $20; Shure xtal mike and stand, $5; Heath TV alignment gen., $20; 3-304TL, $3 each; FOB. Paul Burkhead, 26 Riverview Ave., Battle Creek, Mich.

WANTED—Aircraft radio equipment. Have portable typewriter, TV set, portable phonograph. Bill Romain, 28 Avon Pl., Staten Island 1, N. Y.

FOR SALE—Heath oscilloscope 0-6, $35; audio gen. AG-7, $30; AC voltmeter AV-1, $25; condenser checker C-2, $15; VT voltmeter V-4A, $20, excellent operating con. and appearance, FOB, 10 day money-back guarantee. John Bilane, 109 Normandy Village, Union, N. J.

WANTED—Modulation Transformer, 200 to 300 W. capacity, state mfgr's name, number, price wanted, also dimensions as space it limited. E. P. Shobe, Box 773, Elko, Nev.

SELL OR BUY—Riders manuals submit any offer either way. Also used books on radio. Goodley, 6416 Lindenhurst Ave., Los Angeles 48, Calif.

SELL OR SWAP—Supreme 333 deLuxe analyzer; Precision 500 tube tester; De-Forest Radio-TV course; NRI course in radio in binders. Want ham equipment. George B. Martin, Box 111, Campbell Hall, N. Y.

SALE OR TRADE—15,000 V. Jefferson steel encased Neon Transformer for Sunbeam electric shaver or best cash offer. G. M. Jenkins, Box 60, Doniphan, Mo.

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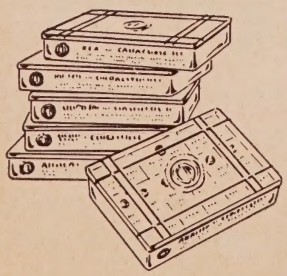

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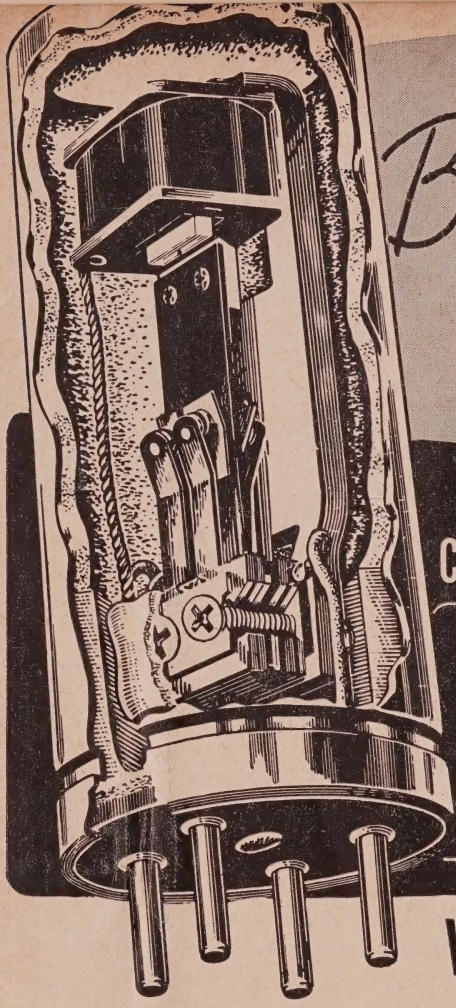

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